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EXAMINER

BHATNAGAR, ANAND P

ART UNIT PAPER NUMBER

2623

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/733,055

Applicant(s)

MILLER, MICHAEL I.

Examiner

Anand Bhatnagar

Art Unit

2623

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28 and 32-40 is/are pending in the application.
- 4a) Of the above claim(s) 26-28 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-25 and 32-40 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04/30/01 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 6, 7, and 8.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: ____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Group II (claims 26 and 27) in the reply filed on 04/12/04 (paper #14) is acknowledged. The traversal is on the ground(s) that the "search and examination can be made without the serious burden" (applicant's amendment paper #14 page 11). This is not found persuasive because as explained in the original restriction that Group I and Group II have separate utilities. Further, Group II (claim 26) has features, such as using a probe to detect normals for landmarks which is not in any claim of Group I.

The requirement is still deemed proper and is therefore made FINAL.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

A.) Claims 1-10, 18, and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Smith et al. (U.S. patent 5,970,499).

Regarding claims 1, 18, and 23: Smith et al. discloses an apparatus for image registration (fig. 1 elements 100, 102, 106, 109, 110, and 114, wherein composite data is formed from multiple data/image types) comprising:

a controller (fig. 1 element 110 wherein the search engine is read as the controller) for selecting at least one reference information structure (fig. 2 elements 214-228, wherein any one or all of the databases are read as the reference information structure(s));

a controller for selecting at least one sensor model (fig. 2 element 202 and column 4 lines 60-62, wherein the template layer is read as the sensor model);
and

a processor for matching image data (fig. 2 elements 200 and 204, wherein the deformation engine, #204, is read as the processor and the patient data, #200, is the image data) to said at least one reference information structure using said at least one sensor model (col. 5 lines 45-48, wherein the reference information structure is mapped to the patient image data using the template layer "sensor model").

Regarding claim 2: The apparatus wherein at least one of said at least one reference information structure comprises an anatomical atlas (fig. 2 element 228).

Regarding claim 3: The apparatus wherein said anatomical atlas comprises a coordinate system (col. 5 lines 40-52, wherein the reference information structure is mapped to the patient image data by using coordinates,

i.e., means that they both inherently have a coordinate points/systems in order for them to correctly match together).

Regarding claim 4: The apparatus wherein at least one of said at least one sensor model comprises a model corresponding to a modality of a sensor used to acquire said image data (fig. 2 elements 200, 202, 234, and 240 and col. 4 lines 60-63, wherein the templates are used to acquire the patient image data and the templates are read as the modality of a sensor.).

Regarding claim 5: The apparatus wherein at least one of said at least one sensor model comprises a model of the distribution of elements representing features in said image data (fig. 2 element 234, col. 3 lines 66-67 and col. 4 lines 1-4, wherein the landmarks are a distribution of anatomical points of the patient image data and the landmarks may be points, lines, volumes, etc. These lines, volumes, etc. are read as a distribution models).

Regarding claim 6: The apparatus wherein at least one of said at least one sensor model comprises a model of the distribution of elements representing anatomical features in said image data (fig. 2 element 234 wherein the landmarks are a distribution of anatomical points of the patient image data and the landmarks may be points, lines, volumes, etc. These lines, volumes, etc. are read as a distribution models).

Regarding claims 7-10: They are rejected for the combination of reasons of claims 1 and 6 above and for the following limitation of: a controller for selecting at least two images (fig. 2 elements 200, 202, 220, and 222 wherein a

image from the imagery database, #222, or from a video database, #220, can be combined with a MR or CT image from the patient data, #200 and/or template layer, #202).

B.) Claims 13-16, 19, 21, 24, 25, and 32-34 are rejected under 35 U.S.C. 102(b) as being anticipated by Kano et al. (U.S. patent 5,359,513).

Regarding claims 13 and 25: Kano et al. discloses an apparatus for image registration (col. 1 lines 14-21) comprising:

- a controller for selecting at least a first image and a second image (col. 2 lines 38-42, wherein a pair of digitized images are matched/registered);

- a controller for selecting at least two distribution models (col. 2 lines 45-50, wherein two dimensional polynomial functions (read as at least two distribution models) are determined and used to match up the pair of images);

- a controller for selecting a distance measure for measuring a distance between at least two of said selected distribution models (col. 2 lines 45-50 and 63-67, wherein the shift values between the images is determined and used to match up the pair of images. This shift value is the misregistration between the images, i.e. the distance measure); and

- a processor for matching at least said first image and said second image using said at least one distribution model and said *distance* measure (col. 2 lines 45-50 and 63-67, wherein the polynomial functions and the shift values are used to match up the image pair).

Regarding claim 14: It is rejected for the same reason as claim 13 above and for the following limitation of: selecting a registration model (Kano et al. fig. 11A element 130 wherein the ROI that is selected is read as the registration model).

Regarding claim 15: The method of claim 14, wherein the step of selecting a registration model comprises the step of:

selecting a registration model corresponding to a sensor modality (col. 5 lines 65-67 and col. 6 lines 1-4, wherein the ROI "registration model" is chosen based on the best match of the template subimage "sensor modality").

Regarding claim 16: The method of claim 14, wherein the step of selecting a registration model comprises the step of selecting a registration model corresponding to a distribution of image elements constituting an image feature (col. 7 lines 13-28, wherein the ROI has a distribution of anatomical structures/features of anatomical structures).

Regarding claims 19 and 24: They are rejected for the same reasons as claim 13 above and for the limitation of: at least one sensor model (Kano et al.; fig. 1A wherein the ROI is read as the sensor model).

Regarding claims 21, 32, and 34: They are rejected for the same reason as claim 13 above and for the following limitation of: a registration model (Kano et al.; fig. 1A wherein the ROI is read as the registration model).

Regarding claim 33: It is rejected for the same reasons as claim 21, 32, and 34 above and for the following limitation of a computer (Kano et al.; col. 3 lines 3-10).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

A.) Claims 11, 12, 20, and 36-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smith et al. (U.S. patent 5,970,499) and Kano et al. (U.S. patent 5,359,513).

Regarding claims 11 and 20: They are rejected for the same reason as claim 6 above and for the following limitation of: segmentation of the first image.

Smith et al. discloses a system to perform image registration of medical images by using features such as an anatomical atlas, landmarks, etc. Smith et al. does not teach to segment an image to perform image registration. Kano et al. teaches to segment a region of interest to perform image registration (Kano et al.; fig. 11A elements 110, 130, and 150, col. 5 lines 65-67, and col. 6 lines 1-4, wherein the region of interest selecting is read as segmenting the image). It would have been obvious to one skilled in the art to combine the teaching of

Kano et al. to that of Smith et al. because they are analogous in performing image registration on medical images. One in the art would have been motivated to incorporate the teaching of Kano et al. to that of Smith et al. in order to enhance and detect possible abnormal regions on the images (Kano et al. col. 2 lines 40-43).

Regarding claim 12: The apparatus wherein the distribution model further comprises a representation of the distribution of elements in an image comprising at least one feature of interest It is rejected for the same reason as claim 6 above. The landmarks are features of the interest which are a distribution of elements of these anatomical features.

Regarding claims 36-38: The apparatus wherein the apparatus is a surgical navigation system (Smith et al.; col. 7 lines 4-6).

B.) Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Doi et al. (U.S. patent 5,982,915) and applicants instant invention's background.

Regarding claim 35: Doi et al. discloses a method for correlating images (Doi et al.; col. 2 lines 45-48) comprising:

selecting a Gaussian registration model comprising at least one of either a sensor model (fig. 1A elements 100-120, col. 5 lines 57-63, and col. 6 lines 18-22, wherein a ROI of interest, the lungs, is select from the gaussian filtered image and this ROI is used to match up the two images), or a distribution model

indicating the distribution of image elements constituting at least one anatomic feature of interest (Doi et al.; col. 6 lines 18-22, where in the lungs are segmented. This region of interest is read as the Gaussian registration model.);

selecting a distance measure incorporating the registration model (Doi et al.; col. 5 lines 40-45 and col. 6 lines 23-26, wherein the disparity of the pixels "global shift" is determined between the two images and the registration model); and

correlating a first image with at least a second image using a transform using said distance measure (fig. 1A elements 114-118, col. 6 lines 42-44, and col. 7 lines 4-7).

Doi et al. discloses to perform image matching/registration between two images by Gaussian filtering and shift value, i.e. distance measure, determination between the two images. Doi et al. does not disclose to use the Kullback-Liebler distance equation to calculate the distance between corresponding points in two images. As disclosed in applicant's instant invention on page 3 that Kullback-Liebler distance is an equation that is used to register corresponding points. One in the art would have been motivated to use the Kullback-Liebler distance equation so that the image registration process would limit the dependency on using the amount of landmarks.

C.) Claims 17, 22, 39, and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Doi et al. (U.S. patent 5,982,915) and Fenster et al. (U.S. patent 4,641,352).

Regarding claims 17 and 22: Doi et al. discloses a method for image registration (Doi et al.; col. 2 lines 45-47) comprising:

selecting at least one landmark in a first image (Doi et al.; fig. 1A element 106 and col. 5 lines 35-40, wherein the rib cage is detected which is read as a first landmark);

determining at least one normal vector for at least one of said selected at least one landmark (Doi et al. element 114, col. 5 lines 40-45, and col. 6 lines 42-43, wherein the shift values of the x and y coordinate points are determined between the two images of the landmark as well as other points. This shift value is read as the normal vector).

Doi et al. discloses to perform image registration by calculating the shift values "normal vectors" between the images. Doi et al. does not disclose to obtain the gradient vectors to perform image registration. Fenster et al. teaches to determine the density amplitude gradients to perform image registration (Fenster et al.; col. 4 lines 31-36 and 65-67, wherein the density amplitude gradients are determined). It would have been obvious for one skilled in the art to combine the teaching of Fenster et al. to that of Doi et al. because they are analogous in image registration. One in the art would have been motivated to incorporate the teaching of Fenster et al. into the teaching of Doi et al. in order to

correct for artifacts generated by the movement of a subject being imaged (Fenster et al. abstract).

Regarding claims 39 and 40: The method of claim 17, wherein the first image is an image of a human body (Doi et al.; fig. 2A, wherein the image is of the human chest cavity).

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Gillick et al. (U.S. patent 5,715,367) for using the Kullback-Liebler distance equation.

Saito et al. (U.S. patent 5,954,650) for a medical image registration apparatus.

Contact Information

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anand Bhatnagar whose telephone number is (703) 306-5914, whose supervisor is Amelia Au whose number is 703-308-6604, group fax is 703-872-9306, and Tech center 2600 customer service office number is 703-306-0377.

Art Unit: 2623

AB

Anand Bhatnagar

Art Unit 2623

June 24, 2004

SMU

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PRIMARY EXAMINER